summers than in wet years. The present is a most unusually dry season, and there is much more water in the creek than there was last year. The Sturt is called 'a river,' but, like most Australian rivers, it is at times only a series of water holes; the water really running under the bed of the river. One can walk across the bed of the river, dryshod, except where the deep holes are. We cannot account for there being a greater body of water, that is, that the springs are stronger during drought than at other times. There are bad accounts from the northern areas. There is no water. The crops, about six inches high, yielding four bushels to the acre. Water is obliged to be carted by rail to some districts, and at the mines on the Peninsula, they are obliged to set the stills to work. In the far north, the new settlers are in fearful straits for want of water, even for drinking. The weather has been more tolerable lately; but hot in the sun, very cold wind in the evening, when a fire is agreeable."

Variable Cygni (Birmingham) 1881

UNDER the above heading, in the *Astr. Nachrichten*, No. 2421 (March 7), Dr. Schmidt, of Athens, gives the results of his observations of this star, which became invisible to him on November 24, and remained so up to his last search for it on December 22. It must have been from rather superior telescopic power—scarcely from a better *atmosphere*—that I was able not alone to see it on December 21, but to recognise its deep crimson colour when no more than 12 mag., and probably less. I used a power of 53 on a 4½ inch object-glass.

Millbrook, Tuam, March 11 J. BIRMINGHAM

A Strange Phenomenon

THE letter under the above heading in NATURE, vol. xxv. p. 410, does not describe a phenomenon altogether unique. A good many years ago a clergyman, well known to me, was passing over a low hill in this parish; while doing so, he encountered a sharp shower of hail, and on approaching the highest point of the ground, he was astonished to find an electrical display similar to that described by Mr. Moir, an elevated walking-stick behaving like a pointed rod on the prime conductor of an electrical machine. I understood that when the clergyman left the summit of the rising ground, the phenomenon disappeared, and that on at once retracing his steps it was again visible. Mr. Moir does not state his position with regard to the contour of the ground, but I strongly suspect that he occupied a position similar to that described above, and that he witnessed a natural display of the common class experiment of presenting a pointed metallic rod to the charged conductor of an electric machine. B.

Fyvie, March 13

STENO[1]

IN the galaxy of genius that glowed in the still dark sky of the seventeenth century some spots shone forth more bright than others, and the keener vision and greater knowledge of later times has detected there stars of surpassing brilliancy. It was a period of great intellectual activity, and there was much independence of thought and freedom of research. In natural science this was quickly felt, and in Italy—elastic Italy!—that first rebounds to every movement, the results were soon made visible. It is not always in the heaving mass itself we first detect it; a foreign body resting on the surface sometimes more clearly indicates the motion. So in the country of Frascatoro, Scilla, Cardano, Cesalpino, Imperati, Aldrovandi, it was a Dane who first put geological Science into shape.

But a very remarkable man was this Dane, Nicholas Steno, and a curious history his. Born at Copenhagen in 1638, the son of a goldsmith in the service of Christian IV., he was brought up in the strictest principles of the Lutheran faith. Instead of following the calling of his father, he was educated for the medical profession, studied under Thos. Bartholin, and attended the lectures of Borrichius and of Simon Paul. Hence the work that first brought him into notice was human and comparative anatomy. Soon after he had obtained the degree of doctor at Copenhagen, he went to Leyden, attracted by the fame of Francis Sylvius, Van Horn, and others. Here he made the acquaintance of Gerard Blasius, to whom without any distrust or reserve he showed his recent discoveries of the parotid gland, and associated ducts, one of which is named after him *Ductus Stenonianus;* but Blasius seems to have dealt unjustly by him in this matter, and to have put forward as his own the discoveries communicated to him by Steno. It was soon, however, apparent that Blasius did not know enough about it to avail himself of the information he had thus gained and unfairly tried to make use of. Steno worked on, tracing by observation and experiment the relations between the salivary and mucous secretions and the blood.

He next turned his attention to the organs of vision and of smell, and in his comparison of the human body with that of the lower animals he may be considered one of the founders of the science of comparative anatomy.

About the year 1657 he published the results of his experiments on the eye of a calf, but he assumed too hastily an exact correspondence between that and the eye of other animals, especially man. In his work on the heart, too, he did not himself arrive at satisfactory results, but he did much to set others on the right line of inquiry, and we do not know how much Lower and other later writers were indebted to the earlier investigations of Steno on this subject. It will be seen that his chief work was that on the glands and various secretions, but it also was incomplete, and it remained for Richard Hall (*Phil. Trans.* vi. p. 3) to make out the true relations of the submaxillary glands.

In 1664 he published some embryological researches in a letter "On the manner in which the chick is nourished in the egg," which, with a letter "On the anatomy of the ray," is appended to his essay entitled "Observationum Anatomicarum de Musculis et Glandulis Specimen" (Copenhagen, 1664, 4to). On embryology he seems to have adopted the views of Marcello Malpighi.

While engaged in these various studies at Amsterdam he heard of the death of his mother, and returned to Copenhagen. After a short stay there he went for a tour through Italy and France, and in 1664 arrived at Paris with a view of carrying on his anatomical researches, now especially devoting himself to the investigation of the brain. In Paris he became intimate with Thevenot, and here also he made the acquaintance of Bossuet. The eloquence and earnestness of that remarkable prelate had such an effect upon Steno, that in 1667 he went over to the Catholics, which perhaps helped somewhat to secure for him the warm reception accorded to him by the Grand-Duke Ferdinand II. and his brother Leopold. He explains the reasons which had induced him to take this step, in a letter published by Fabroni ("Lettere inedite di uomini illustri," vol. ii.). Steno, after leaving Paris and making a tour through the chief towns of Italy, settled at Florence in 1666, where he met Carlo Dati, Francesco Redi, Vincenzo Viviani, and Lorenzo Magalotti. They, in spite of the jealous opposition of Jean Alphonse Borelli, who had had a controversy with Steno respecting the action of the muscles, all agreed in doing him honour, and invited him to become a member of the Academia del Cimento. He was appointed Physician to the Grand-Duke Ferdinand II. de' Medici, and under his protection and patronage had great opportunities of pro-

[1] *Phil. Trans.*, vol. ii. p. 225.
Fabroni.—"Vitæ Italorum," vol iii. p. 7.
Manni.—"Vita del Litteratissimo Mgr. Stenone," Florentiæ, 1775.
Pilla.—E dissertatione N. Stenonis, "de solido intra solidum naturaliter contento excerpta in quibus doctrinas geologicas quæ hodie sunt in honore facile est reperire," Florentiæ, 1842.
A. G. S.—"Biographie Universelle," Paris, 1825.
Lyell.—"Principles of Geology," vol. i., 1830.
Ramsay.—"Passages in the History of Geology." Inaugural Lecture, Univ. Coll. Lond., 1848, p. 10
Capellini.—"Di Nicola Stenone e dei suoi studii geologici in Italia," Inaugural Lecture, University of Bologna, 1869.
Huxley.—Discourse at York meeting, Brit. Assoc., 1881, revised by the Author (NATURE, vol. xxiv. p. 452)

secuting his anatomical studies, as are shown by his further observations on the heart, among which he gives the results of his experiments on the heart of a dog; by his memoirs on the muscles of eagles; on the intestinal movements in cats; and on the bile ducts, &c.

Three years after the publication of these treatises on special points, he brought out his "Elements of Myology," in which he treated the subject more from a mechanical than an anatomical point of view. In a letter to Thevenot, published with this work, he gives an account of the dissection of a shark which had been captured off Leghorn in 1666, and especially discusses the character and mode of growth of the teeth of that animal. This seems to have been a favourite line of inquiry about that time, for next year (1667) Agostino Scilla published his work, "La Vana Speculazione disanganata dal senso," in which, with a view of proving the organic origin of fossils, he figures and describes sharks' heads and teeth, in order to compare them with the glossopietre, or fossil sharks' teeth, so commonly found in the Tertiary beds of Italy.

It was about this time 1667-9 that Steno extended his researches into the field of geology, and began to write a dissertation in Italian for the Academia della Crusca, of which unfortunately only the introduction has been handed down to us. This bears the title "De Solido intra solidum Naturaliter Contento Dissertationis Prodromus." (Florence, 1669, in 4to.)

In this work he showed that he held views far in advance of his age, at any rate that no one else had clearly stated them, for we cannot but feel that in most cases of this sort we have got the wisdom of many and the wit of one. The independent researches of a number of different observers suggest the same explanation, but each is afraid to bring it forward on the evidence that he alone has gathered. A bold clear-headed generaliser steps forward and says, why not accept the conclusions that naturally follow from the hypothesis that each of you severally feel would best explain the various phenomena you have been investigating?

At any rate Steno did give a fair sketch of the Principles of Geology, and showed that he had considered it from the petrological, palæontological, and stratigraphical point of view. He pointed out the difference between rocks of mechanical origin, and those which were due to chemical agencies, and further clearly distinguished those that were to be referred to ordinary subaqueous sediment from those which were the products of eruption.

He found it necessary to mention by way of illustration what any one would admit as soon as their attention was called to it, that if we found a deposit containing sea salt and the remains of marine animals, planks of ships, &c., we should allow that the sea had once been there, whether the bed was exposed in consequence of the sea having retired or because the land had been raised.

A great quantity of timber and things washed down from the land suggest transport by torrents and rivers. Charcoal, cinders, and calcined objects we refer to the action of fire.

If the strata are of the same kind we infer the same causes. But if the character of the deposits which make up a set of beds in one and the same place varies, we refer this to changes in the surrounding conditions affecting the flow, or the source from which the material was derived from time to time.

He further shows that although the lowest beds deposited over any area must conform to the shape of the underlying rock, the tendency of all sediment must be to assume a horizontal position; and so, when we find them highly inclined, we must refer this to subsequent movement, excepting, of course, in the case of false bedding, which probably he would include under his aqueous causes of inclination of strata.

He observes that mountains, often with flat tops, are made up of both horizontal and inclined strata, as may be seen along their flanks, and from all his observations inferred that once the mountains were not, that they do not grow, that there is no constant direction in mountain chains, and he infers that mountain regions are raised and depressed, and subject to rending and fissuring. Discussing the origin of springs, he shows that he had a clear idea on the subject of Artesian wells, which had been previously treated by Ramazzini [De Miranda fontium mutinensium scaturigine, 1596.]

As he had clear notions of the structure of the crust of the earth and of the origin of the sedimentary rocks, we are not surprised to find that he entertained correct views respecting the nature of fossils. He pointed out that some shells were preserved just as they had been left by the sea or lake; others had undergone a slight change, the original shell being altered or replaced, while, in a third case, the shell had perished and left only the cast in the rock. We must remember what queer ideas he had to meet when we read of his explanations and arguments to prove what seems now so clear; for example, how he dwelt upon the occurrence in the rock of a large shell bored by lithodomous mollusks, and had to combat the view that they were concretions! Again a common idea with regard to the sharks' teeth of Malta was that they were the spontaneous productions of the soil, while popular superstition referred them all to the miracle by which St. Paul deprived all the snakes in the island of their venom. So Steno had to meet the argument derived from the great numbers that are there found. He pointed out first that each fish has an enormous number of teeth; next that the sea often carries and collects into one place bodies of the same kind, sorting them, as we know now, according to their size, specific gravity, and so on; and thirdly, that these sharks herd together, so that it was likely there should be a large number of their teeth in one place; and he adds that as there are teeth of different fish as well as shells in the same beds, it was clear that we had to do with an ordinary marine deposit.

He does not seem to have determined the bones of the large mammalia or to have studied their mode of occurrence very carefully, for though he recognised elephants, he did not see the difficulty that arose from the occurrence of a great number of other large animals, nor did he realise in what ancient deposits they were found, and so he thought it a sufficient explanation to say that the elephants had been brought over by Hannibal. He was hampered by the attempt to classify the events of geology under six periods, and had rather to wrest his facts to make them fit with his explanation of the Noachian deluge.

It is less interesting to dwell upon these difficulties than to follow him where he made the great advances of his age, and laid down the simple law of palæontology that when we find a body imbedded in the rocks, and it is similar in all important points to a recent organism, it is a fair inference that it also did belong to such an organism, or when he gave as the result of his investigations that the deposits of past ages and their included remains were produced in just the same way as similar accumulations are formed in modern times, and that the succession of beds with marine shells such as were seen in various parts of Tuscany clearly proved that there had been alternate periods of submergence and of elevation over large areas.

In discussing the possible causes of these earth movements, he touches the question of internal heat, and in inquiring into the causes of hot and cold springs, currents of air of different temperatures, emanation of gases, &c., he speculates upon the effects of the internal heat of the earth, and here and there throws out hints of larger questions working in his mind, as, for instance, modifications of the earth's crust, such that the centre of gravity should no longer so nearly coincide with the

centre of figure; and we cannot but regret that, owing to the sudden interruption which now fell upon his scientific life, that work of which we have but the introduction was never finished, and the many interesting facts as to the changes which had taken place in historic times in Southern Italy were never recorded, and the many curious disquisitions we were led to anticipate are lost for ever.

In 1668 Christian V. offered Steno the Chair of Anatomy at Copenhagen, which he accepted, and entered upon the duties of his office with the delivery of a remarkable inaugural address pointing out the direct benefits that have been derived from the study of anatomy, not only in the alleviation of suffering in others, but from the pleasure of the intellectual pursuit itself. But though his talent was universally recognised, jealousy and bigotry combined to make it uncomfortable for him in his native place, and so he returned to Tuscany, where the Grand-Duke Cosmo III. intrusted to him the education of his son Ferdinand. Steno now began to turn his attention to religious questions, and gave up natural science. He thought he must endeavour to bring about the conversion of his old co-religionists, and wrote several theological works which involved him in a controversy with the reformed clergy of Jena. Innocent XI. rewarded his zeal by appointing him, in 1677, Bishop of Titopolis (*in partibus*), and Apostolic Vicar of Northern Europe.

Steno fixed his residence in Hanover, when the Duke John Frederick of Brunswick had just embraced the Catholic faith; but on the death of this prince in 1679, the electorate fell under the domination of the Bishop of Osnabruck, who belonged to the reformed communion, and would not allow any proselytising to go on in his states. Steno therefore had to leave; and after spending some time at Munster and Hamburg, withdrew to Schwerin, where he died November 25, 1687. His body was, at the request of the Grand-Duke Cosmo III., carried back to Tuscany and laid in the Basilica of S. Lorenzo.

A simple slab of marble, put up by the Catholics whose cause he had espoused, marks the spot. The inscription gracefully records the pious prelate's end. As far as we know, no relative stood by[1]—no man of science pronounced a eulogy over Steno's grave.

The epitaph runs thus:—

NICOLAI STENONIS
EPISCOPI TITOPOLITANI
VIRI DEO PLENI
QUIDQUID MORTALE FUIT HIC SITUM EST
DANIA GENUIT HETERODOXUM
ETRURIA ORTHODOXUM
ROMA
VRTUTE PROBATUM SACRIS INFULIS INSIGNIVIT
SAXONIA INFERIOR
FORTEM EVANGELII ASSERTOREM AGNOVIT
DEMUM
DIUTURNIS PRO CHRISTO LABORIBUS AERUMNISQUE
CONFECTUM
SVERINUM DESIDERAVIT
ECCLESIA DEFLEVIT
FLORENTIA SIBI RESTITUI
SALTEM IN CINERIBUS VOLUIT
A.D. 1687

In this epitaph nothing is said of what Steno did for science, and when the President of the International Geological Congress led the congressists from Bologna to Florence last autumn to place a wreath upon the tomb of Steno, and called upon the distinguished Danish antiquary, Waldemar Schmidt, to say a few words to those assembled round the last resting-place of his illustrious compatriot, it was felt that it would be a fit and pleasing thing to put another slab beside the old one, in memory of that gathering round his grave, and telling of the full appreciation of his worth as a man of science by those who came two centuries after him.

THOS. MCKENNY HUGHES

[1] Jacques-Benique Winslow, an illustrious name in the annals of anatomy, was descended from a sister of Steno, but otherwise we hear no more of his relations.

WIND MEASUREMENTS

SINCE the time of Hooke the accurate measurement of the wind has formed an object of experimental research. That philosopher, if not actually the first to invent an anemometer, at any rate appears to have been the first to write upon the subject, which since then has occupied the attention and exercised the ingenuity of many scientific men. The main result of these efforts was well shown last week at the exhibition of anemometers organised by the Meteorological Society. The President, in an interesting historical address, stated that the number which had been invented was at least one hundred and fifty, and upwards of forty of these were collected, besides photographs and drawings of many others. The exhibition was by kind permission held in the library of the Institution of Civil Engineers, at whose weekly meeting two papers, on the design of structures to resist wind, and the resistance of viaducts to gusts of wind, were very opportunely read.

It is not by any means generally recognised that there are two distinct objects for which the measurement of the wind is necessary; these are: (1) the determination of the actual motion or transference of the air itself; (2) the investigation of the effect of the wind. The two societies above mentioned well represent these two objects of anemometry, and all the instruments are included in one or other of the two classes, which are said to measure respectively the velocity and pressure of the wind. These terms, though convenient, are slightly misleading, as it is really the impulse of the wind which is in both cases measured—in one by its effect in producing the continuous rotation of a vane or set of cups, in the other by its statical effect upon a pressure board or column of air or liquid.

From the nature of the wind it is evident that nothing less than a continuous graphic record could be of much service, and but little progress was made until the invention, about fifty years ago, of self-recording instruments of both classes. The late Dr. Robinson, F.R.S., contributed more than any one else to the establishment of the velocity anemometer which, by the addition of Mr. Beckley's self-recording apparatus, is undoubtedly a model of mechanical invention. Mr. Follet Osler, F.R.S., as the result of much persevering labour and skill, has given to the world a pressure instrument of great excellence, and of this and the former, both of which may be regarded as the best types of the two classes, it may fairly be said that much improvement, at any rate in mechanical construction, can hardly be expected.

As to the tabulation of results, this is conducted with the most scrupulous regularity. Since 1874 the Meteorological Office has published hourly numerical records, from its various stations, of the direction and other elements of the wind. Quarterly records containing engravings of the actual curves are also published. These latter have rather fallen into arrears, the first volume of the new series for 1876 having been only published in 1881; but it is satisfactory to hear that the work of completing them up to the year 1880 is progressing, and it is to be hoped that they will always be continued.

In the face of all this expenditure of time and skill the meteorologist and the engineer alike proclaim the unsatisfactory state of the science. The engineering aspect of the question, viz. the effect of the wind, has recently excited considerable attention in consequence of the Tay Bridge disaster in this country, and of similar accidents abroad. It is evident that with the increase in the size of engineering structures, particularly in exposed situa-